APPENDIX B
UNPAVED ROAD SEDIMENT ASSESSMENT

Yaak River TMDL Planning Area

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1.0 INTRODUCTION

This report presents an assessment of sediment contributions from the unpaved road network within selected watersheds in the Yaak River TMDL Planning Area (TPA). This assessment was performed as part of the development of sediment TMDLs for 303(d) Listed stream segments with sediment as a documented impairment.

The Yaak TPA (USGS HUC ID #17010103) is located in the remote northwest corner of Montana in Lincoln County. The Yaak TPA extends into Canada along the northern Montana border and drains to the Kootenai River six miles downstream of the town of Troy. The 2006 303(d) List identifies three stream segments as impaired for sediment: Seventeenmile Creek, Lap Creek, and South Fork Yaak River. This road assessment addresses road sediment load estimations and reductions for Lap Creek, Seventeenmile Creek, and the South Fork Yaak River.

Objectives of the assessment include the following.

- Estimate existing annual sediment loads to streams derived from road crossings and contributing (parallel) road segments in the Yaak TPA, specifically in impaired watersheds, Seventeenmile Creek, Lap Creek, and South Fork Yaak River.
- Assess culvert condition and risk associated with chronic and acute culvert failure in the Yaak TPA, specifically in impaired watersheds, Seventeenmile Creek, Lap Creek, and South Fork Yaak River.
- Estimate potential sediment loading reductions from the forest road network in watersheds, Seventeenmile Creek, Lap Creek, and South Fork Yaak River.
- Assess fish passage capabilities at selected culvert locations within Seventeenmile Creek, Lap Creek, and South Fork Yaak River.

Roads located near stream channels can impact stream function through degradation of riparian vegetation, channel encroachment, and sediment loading. The degree of sediment loading is determined by a number of factors including road type, construction specifications, drainage, soil type, topography, and precipitation. Using a combination of GIS analysis, field assessment, and modeling, estimated sediment loads were using the *WEPP: Road* model. Existing sediment loads from roads were estimated, as were as potential sediment load reductions. Existing culverts were also assessed for fish passage and culvert failure risk using culvert data collected by the Yaak Headwaters Restoration Partnership (YHRP) in 2004 – 2006.

2.0 DATA COLLECTION

The Yaak Road Sediment assessment consisted of three primary tasks.

1. Selection of modeling approach and development of a Sampling and Analysis Plan (SAP)
2. Field assessments of road networks and culverts
3. Modeling of sediment loads and reduction potential

Additional information on assessment techniques is available in prior reporting for this project: *Road GIS Layers and Summary Statistics* (DEQ, 2007), and *Yaak Roads Assessment: Sampling and Analysis Plan* (DEQ, 2007).

2.1 Spatial Analysis

Using road layers provided by the Kootenai National Forest (KNF), road crossings and parallel segments in the road network were identified and classified by road type (Table B-1) relative to 7^{th} code subwatershed.

Table B-1. Kootenai National Forest Road Type Classifications

IGBC Code	KNF Road Classification
1	Impassible to Motorized Vehicles
2	Restricted/Legally Gated Admin Use
3	Barriered/Legally No Admin Use
4	Open for Public Use

Crossings statistics were developed based on 7^{th} code subwatershed for the three sediment listed watersheds to be addressed in this road assessment. There are 23 unpaved road crossings in the Lap Creek Watershed, 108 unpaved crossings in the Seventeenmile Watershed, and 123 unpaved crossings in the South Fork of the Yaak Watershed (Attachment A—Table B-8). Field assessment work focused on the unpaved road crossings in these three watersheds. No roads were assessed outside of Seventeenmile Creek, Lap Creek, or South Fork Yaak River Watersheds.

Over the past 15 years, many roads in the Yaak TPA have been closed and/or have had travel restrictions placed on them in order to preserve grizzly bear habitat. Roads within Grizzly Bear Core Management Area (Core) designation are closed to all motorized traffic, while other roads are closed to public use and are used minimally for administrative use only. These closures and travel restrictions have resulted in drastically different conditions on closed vs. open roads. Closed roads typically have vegetative growth over most if not all of the road surface, and in many instances woody vegetation dominates the (previous) travel corridor. Sediment production and delivery from these roads is substantially lower than that observed on open roads.

A random subset of unpaved crossing sites was generated for field assessment based on the proportion of total unpaved crossings within the Lap Creek, Seventeenmile Creek (upper and lower), and South Fork of the Yaak River Watersheds with approximately 20% of the crossings assessed (52 sites). Parallel road segments were identified as areas where roads encroach upon the stream channel, and total road lengths within 50-foot and 100-foot buffer zones were generated.

2.2 Field Data Collection

A total of 49 unpaved crossings and 2 unpaved parallel segments were randomly selected for field evaluation. Twenty six crossings were assessed in the South Fork of the Yaak River (21% of total), twenty one 21 were assessed in Seventeenmile Creek (19% of total), and two were assessed in Lap Creek (9% total). Due to limited field time and budget, some adjustments of the random GIS crossing selection were made, as many of these sites required significant hiking to reach. Crossings, at a lower percentage, were assessed in Lap Creek due to the fact that 22 of 23 crossings were in Core management areas requiring substantial effort and time to reach. An assumption was made that all crossings within Lap Creek Core areas are similar in condition to the assessed sites. Two crossings in the South Fork of Yaak had been decommissioned (culverts pulled and road grades obliterated) and were removed from the loading analysis.

In the field, parallel road segments were selected based on best professional judgment while traveling roads on which specific crossings were selected for evaluation. Parallel segments were selected in a manner where road segments would not be duplicated in both the crossing and parallel sediment load calculations. Two parallel segments were assessed in the Yaak TPA, one in the South Fork of the Yaak River and one in Upper Seventeenmile Creek. Based on field reconnaissance, it was determined in the field that parallel road segments were not a significant source of sediment loading unless the stream buffer was very small (less than 20 feet) due to the extremely dense forest vegetation and stream buffers. Extensive travel within Seventeenmile Creek and the South Fork Yaak River watersheds confirmed the non-significance of parallel segment contributions. As a result, parallel segments were only assessed if located very near a stream and if evidence of sediment delivery was noted. One parallel segment, representative of the dense vegetation conditions and low sediment delivery, was measured (SFY-4A-P), as well as one segment where the road was located very near the stream and delivery was high, relatively (USC-2A-P). Field data spreadsheets with detailed information on each road crossing and parallel segment are included in Attachment B.

2.3 Sediment Assessment Methodology

The road sediment assessment was conducted using the ***WEPP:Road*** forest road erosion prediction model (http://forest.moscowfsl.wsu.edu/fswepp/). WEPP:Road is an interface to the Water Erosion Prediction Project (WEPP) model (Flanagan and Livingston, 1995), developed by the USDA Forest Service and other agencies, and is used to predict runoff, erosion, and sediment delivery from forest roads. The model predicts sediment yields based on specific soil, climate, ground cover, and topographic conditions. Specifically, the following model input data was collected in the field: soil type, percent rock, road surface, road design, traffic level, and specific road topographic values (road grade, road length, road width, fill grade, fill length, buffer grade, and buffer length). In addition, supplemental data was collected on vegetation condition of the buffer, evidence of erosion from the road system, and potential for culvert failure.

Site specific climate profiles were created using data from the Western Regional Climate Center (http://www.wrcc.dri.edu). Due to the lack of available long-term precipitation stations in the Yaak TPA, one station from outside the planning area was selected to model the higher elevation sites (>3,500 feet). The selected station, Burke 2 ENE, Idaho (101272), contained similar climate and elevation conditions as those encountered in the Yaak (48.9 inches annual precipitation; 4090 feet elevation). The Troy 18N, Montana (248395), station was used to model the lower elevation sites below 3,500 feet in elevation (35.60 inches annual precipitation; 2,720 feet elevation). Thirty year simulations were run for each unpaved road crossing segment.

Field assessment revealed that a large number of roads within Core management areas and roads with administrative or barriers to limit access were completely vegetated and contained significant downfall and understory on the road prism. The WEPP:Road model did not account for these road vegetation conditions; as a result, some adjustments were made to the model to more appropriately represent these types of roads. Attachment C contains a description of model adjustments, as recommended by the model author (Elliot, pers comm).

2.4 Mean Sediment Loads from Field Assessed Sites

Field assessment data and *WEPP:Road* modeling results were used to develop sediment loads based on various watershed criteria. A standard statistical breakdown of loads from the unpaved road network within each sediment-listed watershed was generated using an applicable dataset of field assessed sites. Mean load and contributing length, median load, maximum and minimum loads, and 25th and 75th percentile loads were calculated for unpaved road crossings within the three 6th code subwatersheds that were the basis of the field assessment. Mean sediment loads from unpaved road crossings were estimated at 0.18 tons/year in the South Fork of the Yaak River Watershed, 0.40 tons/year in the Seventeenmile Creek Watershed (0.47 tons/year – Upper, 0.27 tons/year-Lower), and 0.01 tons/year in the Lap Creek Watershed. A statistical summary of sediment loads for field assessed sites are included in Table B-2.

Table B-2. Sediment Load Summary for Field Assessed Sites by Listed Watershed

Statistical Parameter	South Fork Yaak River	Lower Seventeenmile Creek	Upper Seventeenmile Creek	Lap Creek	Total of Field Assessed Crossings
Number of Sites (n)	24	7	14	2	47
Mean Contributing Length (ft)	290	316	365	300	317
Mean Load (tons/year)	0.18	0.27	0.47	0.01	0.27
Median Load (tons/year)	0.08	0.05	0.04	0.01	0.04
Maximum Load (tons year)	1.24	1.05	2.89	0.011	2.89
Minimum Load (tons/year)	0.0002	0.0006	0.0002	0.0003	0.0002
25th Percentile (tons/year)	0.003	0.015	0.028	N/A	0.01
75th Percentile (tons/year)	0.25	0.38	0.21	N/A	0.26

The sediment load summary shows large differences between minimum and maximum load values, as well as between mean and median values. These data suggest that a small number of high sediment load crossing sites impact the average values significantly. Mean sediment loads were calculated and classified based on KNF road types. Results are shown in Table B-3. Clearly, roads that have restricted use (IGBC classification 1, 2, and 3) have much lower sediment loading estimates than those that are open to public use (IGBC classification 4) due primarily to absence of motorized travel resulting in vegetative recovery on road surfaces.

Table B-3. Mean Stream Crossing Sediment Loads by Road Type

KNF Road Classification (IGBC)	Number of Sites Assessed	Mean Contributing Length (ft)	Mean Sediment Load (tons/yr)
1 – Impassible to Motorized Vehicles	4	170	0.001
2 – Restricted/Legally Gated Admin Use	15	268	0.06
3 – Barriered/Legally No Admin Use	10	207	0.11
4 – Open for Public Use	18	451	0.60

Two assessed crossing sites had been reclaimed by USFS with culverts removed and road grades obliterated (SFY-2B and 3B). As a result, these two crossings were not included in the road crossing loading analysis. Due to the small number of parallel road assessments observed and sampled in the field and the minimal impact noted, a mean parallel road segment load was not calculated. A summary of modeling results from field assessed sites is located in Attachment B.

3.0 UNPAVED ROAD NETWORK SEDIMENT ANALYSIS

Estimates of mean sediment loads from road crossings, parallel road segments, and culvert failure were extrapolated to all sites within the Seventeenmile Creek, Lap Creek, and South Fork Yaak River Watersheds.

3.1 Sediment Load from Road Crossings

Mean sediment loads from field assessed sites from each road type were used to extrapolate loads throughout the three impaired watersheds which are Seventeenmile Creek, Lap Creek and South Fork Yaak River. Mean loads for unpaved crossings (Table B-4) were applied to the total number of crossings within these three watersheds at the 7th code HUC scale. The total modeled sediment load from unpaved crossings in Seventeenmile Creek, Lap Creek, and South Fork Yaak River watersheds is 23.7, 2.37, and 21.29 tons/year respectively. The majority of sediment load is generated from crossings on roads open to public use (IGBC code-4). Road crossing sediment loading estimates for sediment-impaired watersheds, Seventeenmile Creek, Lap Creek, and South Fork Yaak River at the HUC 7 scale are given in (Attachment A—Tables B-9, B-10, and B-11).

It should be noted that sediment loading estimates are based on extrapolated model results and may not be accurate representations of actual sediment loading values. Sediment loading estimates are more appropriate as relative estimates and can provide resource managers with tools to allow for better prioritization and planning of restoration activities designed to reduce sediment loading.

3.2 Sediment Load from Parallel Road Segments

The two field-assessed parallel road segments in the Yaak TPA showed very different modeling results, with site SFY-4AP having a load of 0.02 tons/year and site USC-2AP having a load of 1.13 tons/year. Site SFY-4AP contained an average buffer distance of 70 feet and site USC-2AP had an average buffer distance of 10 feet. The majority of parallel sites observed in the field contained buffer distances greater than 50 feet and were heavily vegetated, with no evidence of sediment delivery to the stream. USC-2AP was the only parallel site where evidence of sediment loading was noted. Figures B-1 and B-2 are included to show differences in the typical buffer conditions of the two parallel segments assessed.

Figure B-1. Parallel Segment SFY-4A-P – Average Buffer Distance 70 feet

Figure B-2. Parallel Segment USC-2A-P – Average Buffer Distance 10 feet

Field observations within Seventeenmile Creek and the South Fork Yaak River Watersheds indicated that the vast majority of parallel road segments do not contribute significant sediment to streams, and buffer distances must be very small for impacts to occur. This conclusion was drawn based on observations in the three assessed subwatersheds only and the fact that nearly the entire road network within these areas was traveled during fieldwork. Site USC-2A-P was the only site where evidence of delivery was noted. Also, a large portion of parallel road distance calculated in the GIS layers is present at road crossing locations and is accounted for in the crossing load calculations. As a result, parallel road segments are likely a minor contributor to overall sediment loading from the unpaved road network with isolated locations where roads are very close to streams. Due to the small buffer distance required to have a significant parallel impact, the use of GIS layers to identify these areas and extrapolate loads is not feasible since these layers are often not accurate to this level resolution.

3.3 Culvert Assessment

Culvert crossing assessment and analysis within the Yaak TPA was conducted in order to achieve the following.

- Assess the ability of existing culverts to allow fish passage
- Assess chronic and acute culvert failure

Data from a detailed culvert study conducted by the Yaak Headwaters Restoration Partnership (YHRP) from 2004 - 2006 was used to complete the analysis, along with data collected during the road sediment field assessment in June 2007. Global positioning system data from sites assessed during the road sediment assessment were compared to those collected at YHRP sites. Using a snap feature in GIS, road assessment sites were linked to the closest YHRP site. Sites located within 200-feet of each other were considered to be the same location, due to variations in measurement and GPS accuracy. These sites were then checked against maps provided by the YHRP to determine accuracy. Crossing sites with bridges and decommissioned sites were removed from the dataset, as were sites that contained missing or incomplete data.

3.3.1 Fish Passage at Culverts

The fish passage assessment provided herein should be considered a coarse filter that identifies culverts as having probable fish passage issues. These may be used as a starting point for prioritization of planning efforts designed to address culvert deficiencies within the Yaak TPA so that full support for aquatic life uses may be restored. It must be noted that this evaluation of fish passage through culverts aims to assess the capability of a culvert to allow juvenile fish passage and does not consider whether associated streams are fish-bearing or assess the fishery resource value. Further analysis should be conducted in order to properly prioritize and plan implementation activities in order to meet restoration goals.

For the purposes of this assessment, a culvert is considered to be a blockage to fish passage if it fails to allow passage of juvenile fish species (typically salmonids). In evaluating the ability of existing culverts to allow for fish passage, a variety of obstacles to fish passage were considered: constriction ratio, culvert gradient, and culvert outlet vertical barriers (perch). In order to quickly assess the ability of existing culverts to allow for fish passage, evaluation criteria for the Yaak TPA were adopted from USDA Forest Service Region 1 fish passage criteria (Figure B-3). The evaluation criteria classify culverts by type and establish thresholds for the following.

- culvert gradient
- stream constriction

- outlet drop (perch)

Each culvert is placed into one of the three classifications based on whether criteria are met or not.

1. GREEN: conditions that have a high certainty of providing juvenile fish passage.
2. RED: conditions that have a high certainty of not providing juvenile fish passage.
3. GREY: conditions are such that additional and more detailed analysis is required to determine juvenile fish passage ability.

Table B-4. USDA Forest Service Region 1 Juvenile Fish Passage Evaluation Criteria

Structure Type	GREEN	GREY	RED
Circular CMP $\leq$ 48" * w/Spiral Corrugations	Culvert gradient <0.5% No perch Constriction ratio >0.70	Culvert gradient 0.5% to 1.0% Perch < 4" Constriction ratio 0.5 to 0.70	Culvert gradient > 1.0% Perch > 4" Constriction ratio < 0.5

** the predominant culvert type in the Yaak TPA*

With the exception of mainstem segments of Seventeenmile Creek and South Fork Yaak River, most stream and culvert grades are greater than 1.0%, thereby placing nearly all culverts (97%) assessed in the red category based solely on culvert gradient. When the suite of criteria (culvert gradient, perch, constriction ratio) was considered, no culverts met the "green" classification.

Evaluation of individual criterion was conducted in order to assess the spatial distribution of culvert sites not meeting both individual criterion and the suite of criteria given in Table B-4. Figure B-4 shows the percent of culverts within Seventeenmile Creek, Lap Creek, and the South Fork Yaak River that currently do not meet individual passage criterion. Figures B-5 through B-7 display the distribution of this data throughout the three watersheds.

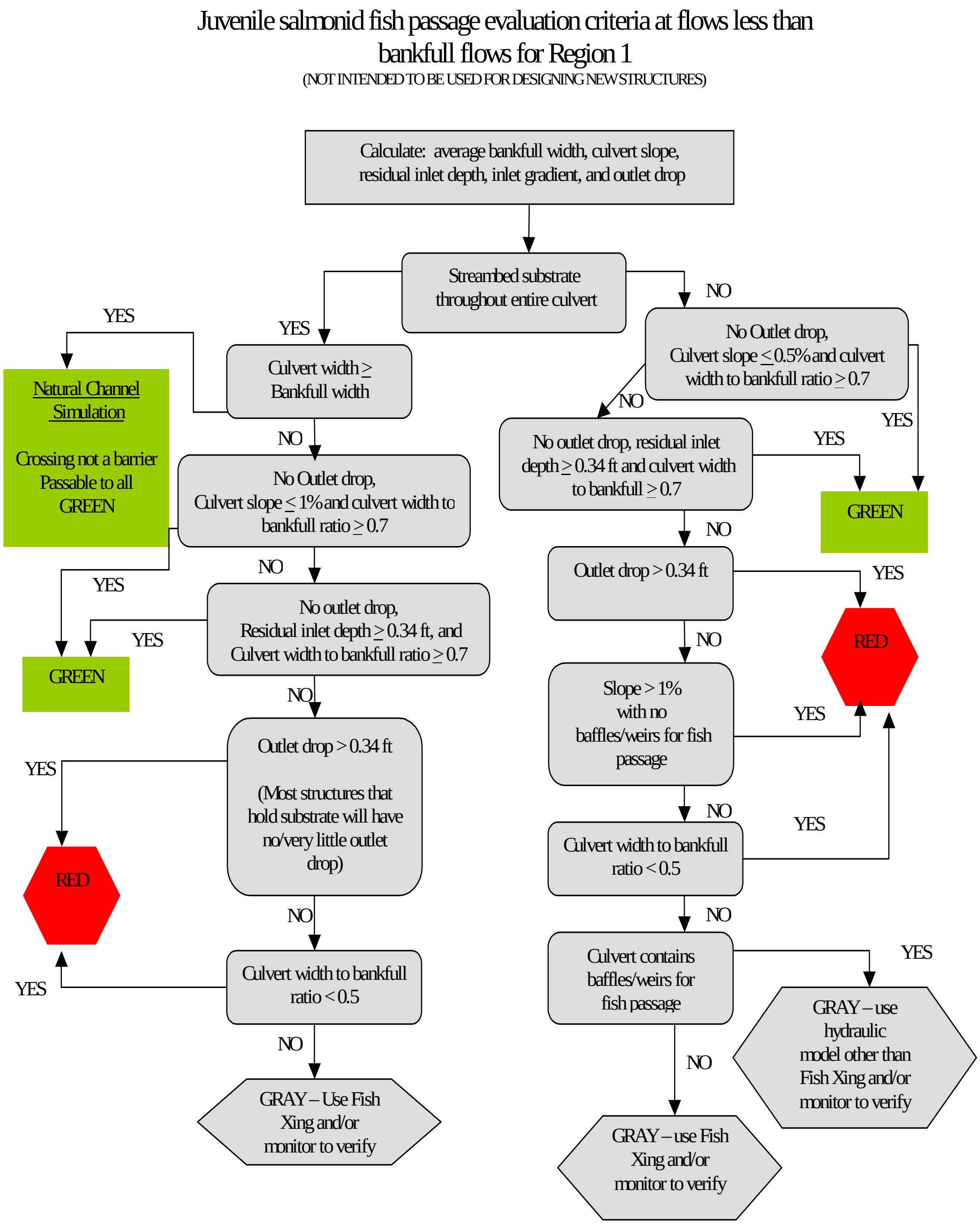

Figure B-3. Northern Region Juvenile Salmonid Passage Screening Schematic

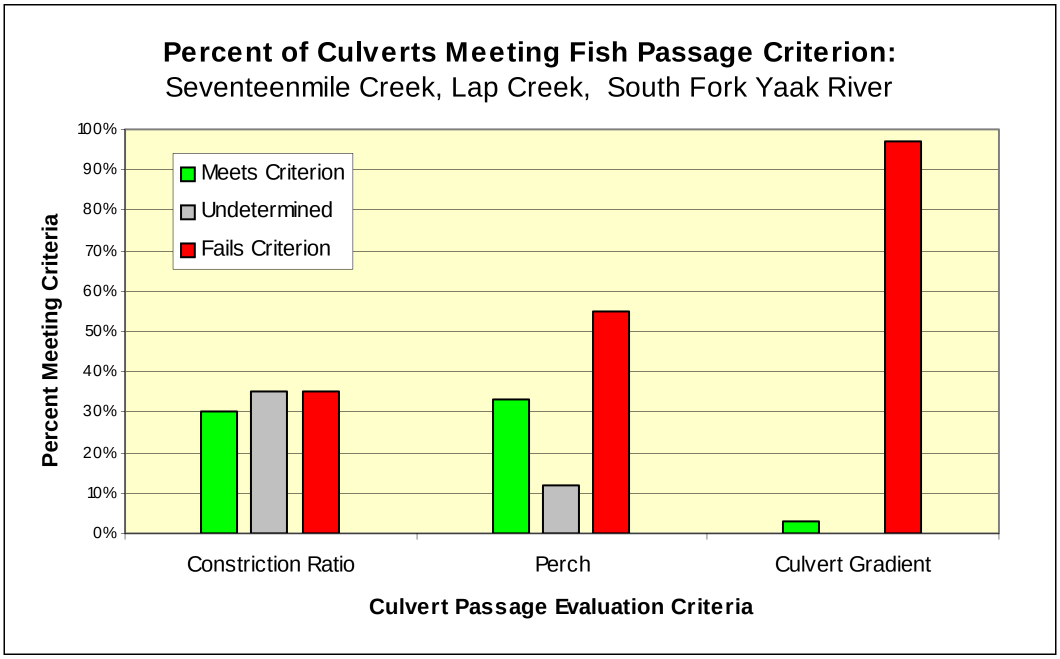

Figure B-4. Percent of Culverts Meeting Fish Passage Criterion

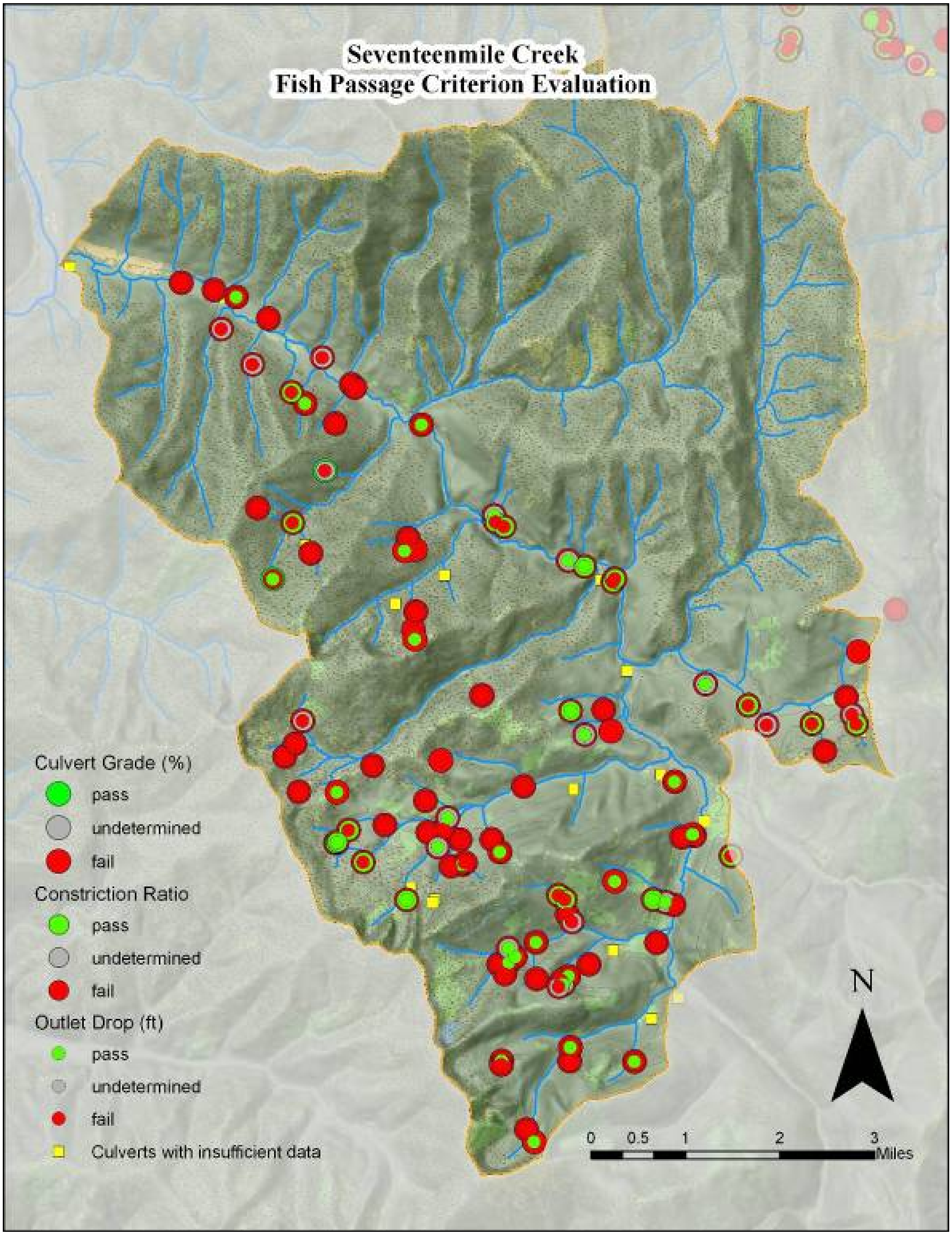

Figure B-5. Seventeenmile Creek Fish Passage Criterion Evaluation

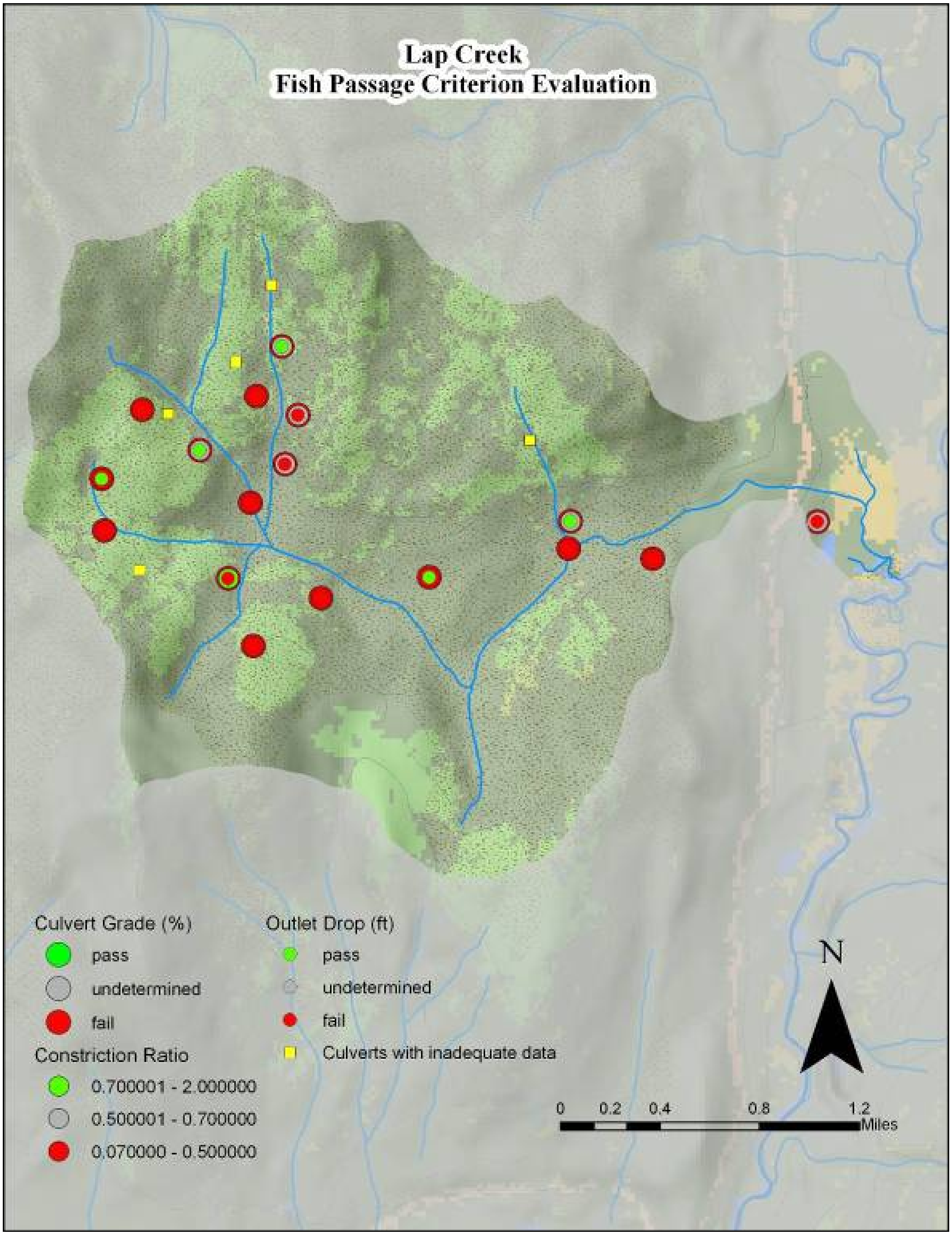

Figure B-6. Lap Creek Fish Passage Criterion Evaluation

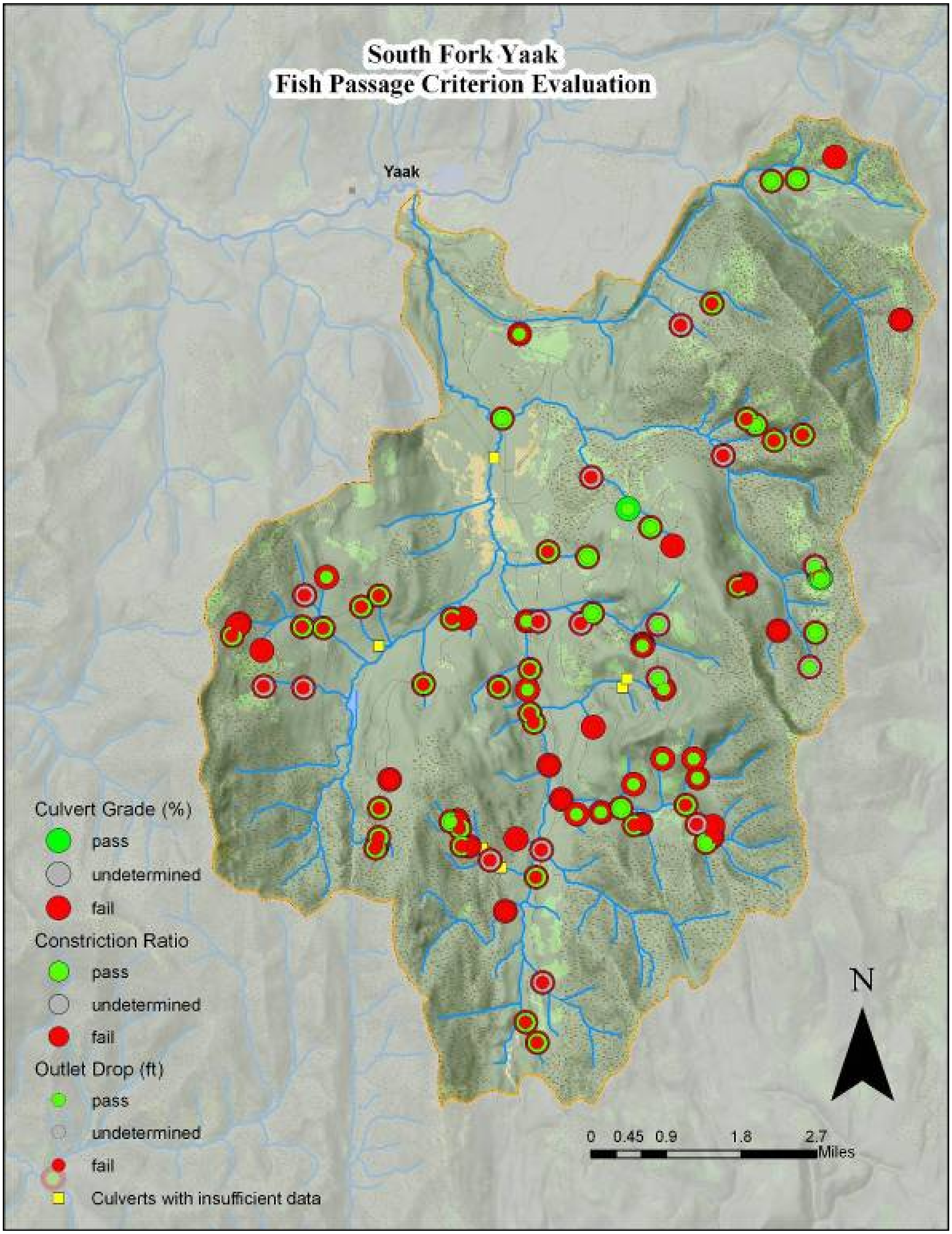

Figure B-7. South Fork Yaak River Fish Passage Criterion Evaluation

3.3.2 Culvert Failure Assessment

Culvert 'failure' is typically associated with rerouting of stream channels away from or out of culverts as a result of high flow events. For the purposes of this assessment, however, *culvert failure* is considered any significant sediment delivery to stream channels as a result of improper sizing, placement, or maintenance of road crossing culverts. It is assumed that properly sized, installed, and maintained culverts are capable of passing flow and debris of all but the most severe events, and do not contribute sediment loads above what would be deemed 'naturally occurring.' Culvert 'failure' may consist of rerouting of stream channels and associate acute road fill delivery to stream channels , or (more likely) culvert failure may result in lesser amounts of chronic sediment delivery due to channel scour, road scour from overtopping, culvert undercutting, or road fill failure due to improper placement, undersizing and/or lack of maintenance.

Evidence of chronic culvert failure such as constriction, blockage, overtopping, misalignment, outlet drops, and undercutting is not uncommon at culvert crossings in the Seventeenmile, Lap, and South Fork Yaak Watersheds (YHRP 2004-2006, Newgard pers comm). In some cases[1] culvert failures in the Yaak TPA have resulted in road washouts that have delivered significant sediment loads to adjacent streams. In other cases, debris blockages at culvert inlets and evidence of culvert overtopping, undercutting and scour demonstrate sediment delivery and the potential for more significant failure if culvert deficiencies and maintenance issues are not addressed. Ten Percent of culverts assessed by the YHRP (n >200) had blockages of 25% or greater at the culvert inlet, and nearly half of these showed evidence of culvert overtopping (Figures B-8 -B-10).

Constriction ratio (the ratio of culvert width to channel width) is used to evaluate the capabilities of culverts to pass high flows and associated debris. Culverts with widths less than bankfull stream widths were considered undersized, and pose a potential risk of acute and chronic failure, channel scour, and debris accumulation, particularly under high flow conditions. Of the more than 180 culverts assessed for constriction, 67% had constriction ratios <0.7 and 24% had constriction ratios of <0.4.

As culvert failure (chronic and acute) consists of a variety of processes, and is influenced by historical sizing and placement, and also past and present maintenance and management, the development of sediment loading estimates due to culvert failure (chronic and acute) is problematic. Sediment load estimates from culvert failure, therefore, are not calculated; rather, allocations provided to culvert failure in Section 6.0 reply on a performance-based approach following guidelines provided in the Inland Native Fish Strategy (USDA, 1995).

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[1] Lap Creek site 200, South Fork Yaak sites 55, 74 & 90, and Seventeenmile Creek sites 33, 37 & 61

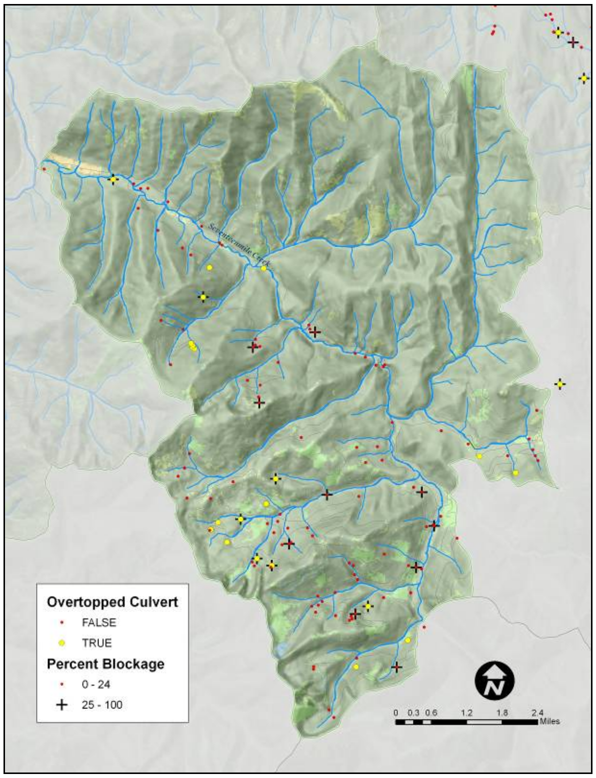

Figure B-8. Seventeenmile Creek – Overtopped and Blocked Culverts

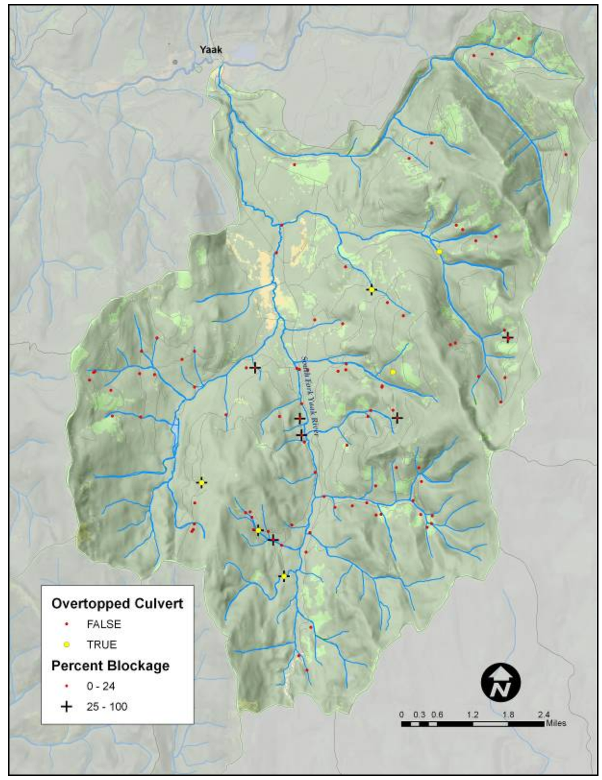

Figure B-9. South Fork Yaak River - Overtopped and Blocked Culverts

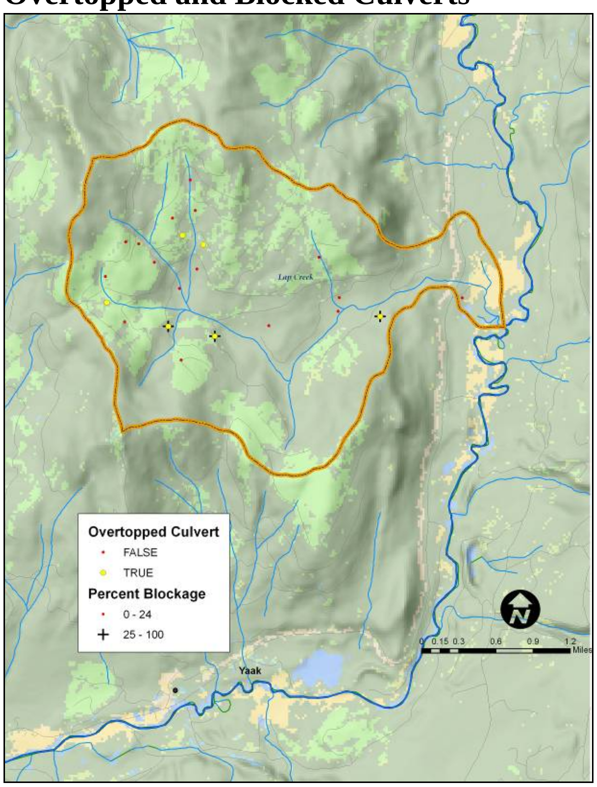

Figure B-10. Lap Creek - Overtopped and Blocked Culverts

3.4 Total Estimated Road Network Sediment Load

Total existing sediment load from the road network in Seventeenmile Creek, Lap Creek, and South Fork includes sediment loads from road crossings and road parallel segments (Table B-5). Loads from parallel segments are not significant (see Section 3.2) and are therefore not calculated for the purposes of this assessment. Sediment loads from stream crossings is thought to be the most significant *chronic* source of sediment to streams as delivery of sediment can occur throughout the year in response to precipitation and snowmelt events.

Table B-5. Total Estimated Road Network Sediment Load

Watershed	Road Sediment Sources		Total Load (tons/yr)
	Stream Crossing Load	Parallel Road Load	
Seventeenmile Creek	23.7	NA	23.7
Lap Creek	2.37	NA	2.37
South Fork Yaak River	21.3	NA	21.3

4.0 Sediment Reductions from Roads

Sediment derived form the unpaved forest road network is the primary source of anthropogenic sediment loading in the Yaak TPA and has been identified as a cause of impairment of aquatic life uses.

As defined in ARM 17.30.623 (f) "*No increases are allowed above **naturally occurring** concentrations of sediment or suspended sediment (except as permitted in 75-5-318 , MCA) , settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.*"

"Naturally occurring" *is defined as "conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil and water conservation practices have been applied*" (ARM 17.30.602 (19)).

Estimated sediment load reductions from the forest road network are based on the assumption that some sediment from roads is acceptable as long as beneficial uses are maintained through the application of "*all reasonable land, soil and water conservation practices*." In the case of sediment derived from forest roads, a surrogate sediment loading condition is established that represents the application of 'all reasonable conservation practices' and is based on the following criteria.

- Contributing road length at BMPed crossings $\leq$ 200 feet on open roads
- Road crossing density $\leq$ 1.5 crossings/mi^2 at the 7th Code HUC scale
- New culverts on unpaved forest roads are sized and installed to pass the 100-year flow (Q100) and associated debris (INFISH, 1995)
- Existing culverts are maintained and upgraded (consistent with INFISH guidance) to limit sediment contributions from chronic failure.
- Road segments parallel to streams maintain all appropriate BMPs to minimize sediment loading to streams

The resultant numeric sediment load from the forest road network, considering 1) a contributing road length on open, traveled roads of $\leq$ 200 ft at BMPed stream crossings, 2) a road crossing density $\leq$ 1.5 crossings/mile^2, 3) culverts capable of passing the 100-year flow event, and 4) application of all appropriate BMPs along parallel road segments is considered a 'naturally occurring' (ARM 17.30.602 (19)) condition and provides a numeric basis for sediment allocations to forest road networks in the Yaak TPA. Based on these criteria, the **modeled numeric allowable unit load from the forest road network is 0.20 tons/year/mi^2.**

In order to estimate the acceptable sediment loading from forest roads based on these criteria, the aforementioned criteria were applied to the existing modeled sediment loads (see Attachment A—Tables B-12, B-13, and B-14) at the 7th code HUC level.

4.1 Contributing Road Length and Road Crossing Density Load Reductions

Sediment loads from contributing road length reductions were assessed by modeling a length reduction to 200 feet using the WEPP:Road forest road erosion prediction model. A contributing road length of 200 ft or less represents application of "reasonable conservation practices" on forest roads and may be achieved through a variety of BMPs, to be determined based on site-specific characteristics. Because the existing condition of roads within IGBC classifications 1, 2, and 3 are presently producing relatively little sediment, and the application of BMPs on these roads is limited by access considerations, contributing road length scenarios were only applied to roads that are currently open to public use (IGBC Code 4).

On IGBC Code 4 crossings where contributing road length exceeded 200 feet, contributing road lengths were reduced to the corresponding post-BMP scenario of 200 feet. No changes were made to crossing locations where the contributing road length was less than the 200 feet. Reduced mean sediment loads were then extrapolated to the watershed scale in the same manner in which the existing sediment loads were calculated. By reducing road segments to a maximum 200 foot contributing road length scenario, mean sediment loads were reduced from 0.60 tons/year to 0.13 tons/year for IGBC code 4 road crossings. Table B-6 shows the resultant loading values (in **bold**) based on these reductions.

Table B-6. Existing and BMP Mean Sediment Loads by KNF Road Type

KNF Road Classification (IGBC)	Existing Conditions		BMP Scenario	
	Mean Contributing Length (ft)	Mean Sediment Load (tons/yr)	Mean Contributing Length (ft)	Mean Sediment Load (tons/yr)
1 – Impassible to Motorized Vehicles	170	0.001	170	0.001
2 – Restricted/Legally Gated Admin Use	268	0.06	268	0.06
3 – Barriered/Legally No Admin Use	207	0.11	207	0.11
4 – Open During Bear Season	451	0.60	**200**	**0.13**

A road crossing density value of 1.5 crossings per square mile was applied to the reduced mean sediment loads given in Section 5.1. Watershed areas for all 7th code HUCs were multiplied by 1.5, and the result was multiplied by the loading rate of 0.13 tons/mile^2 to obtain the allowable sediment load from road surfaces for each 7th code HUC (Attachment A—Tables B-12, B-13, and B-14). Normalized to watershed area, the allowable load from road surfaces equates to ~0.20 tons/mi^2/yr.

4.3 Sediment Load Reduction Summary

Estimated sediment load reductions from the forest road network are based on the assumption that some sediment from roads is acceptable as long as beneficial uses are maintained through the application of "*all reasonable land, soil and water conservation practices*." In the case of sediment derived from forest roads, a surrogate sediment loading condition is established that represents the application of 'all reasonable conservation practices' and is based on the following criteria.

- Contributing road length at BMPed crossings $\leq$ 200 feet on open roads
- Road crossing density $\leq$ 1.5 crossings/mi^2 at the 7th Code HUC scale

- New culverts on unpaved forest roads are sized and installed to pass the 100-year flow (Q100) and associated debris (INFISH, 1995)
- Existing culverts are maintained and upgraded (consistent with INFISH guidance) to limit sediment contributions from chronic failure.
- Road segments parallel to streams maintain all appropriate BMPs to minimize sediment loading to streams

Because sediment loads from parallel road segments are not considered significant within Seventeenmile Creek, Lap Creek, and South Fork Yaak River, calculated reductions are not provided for this sediment source. Potential sediment load reductions summaries for stream crossings are given below in Table B-7.

Table B-7. Sediment Load Reduction Summary: Stream Crossings

Watershed	Existing Stream Crossing Load (tons/yr)	Reduced Stream Crossing Load (tons/yr)	Percent Reduction
Seventeenmile Creek	23.7	12.16	49%
Lap Creek	2.37	1.13	52%
South Fork Yaak River	21.3	12.23	43%

5.0 REFERENCES

Lyman, C.A. 2005. Fish Passage at Road Crossings Assessment: Caribou-Targhee National Forest FY2005.

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ATTACHMENT A

Kootenai National Forest Road Types by 7th Code HUC

Table B-8. KNF Road Types by 7th Code HUC

HUC7_Name	HUC6_Name	IGBC Code				Total
		1	2	3	4	
Big Foot Cr	Upper Seventeenmile Creek	0	5	0	5	10
Flattail Cr	Upper Seventeenmile Creek	0	2	6	6	14
Hemlock Cr	Upper Seventeenmile Creek	2	0	0	0	2
Lost Fork Cr-1	Upper Seventeenmile Creek	6	9	0	0	15
Lost Fork Cr-2	Upper Seventeenmile Creek	1	2	0	0	3
Seventeenmile Cr U-1	Upper Seventeenmile Creek	0	4	0	2	6
Seventeenmile Cr U-2	Upper Seventeenmile Creek	0	4	4	7	15
Bridle Cr	Lower Seventeenmile Creek	1	0	0	0	1
Conn Cr	Lower Seventeenmile Creek	13	0	0	0	13
Crum Gulch	Lower Seventeenmile Creek	0	0	0	1	1
Mule Cr	Lower Seventeenmile Creek	6	0	0	0	6
Pelham Cr	Lower Seventeenmile Creek	4	0	0	0	4
Seventeenmile Cr L	Lower Seventeenmile Creek	4	0	0	13	17
Seventeenmile Cr NF	Lower Seventeenmile Creek	0	0	0	1	1
Saddle Cr	Lower Seventeenmile Creek	0	0	0	0	0
Grush Gulch	Lower Seventeenmile Creek	0	0	0	0	0
Sheepherder Cr	Lower Seventeenmile Creek	0	0	0	0	0
Papoose Cr	Lower Seventeenmile Creek	0	0	0	0	0
Seventeenmile Creek Totals		**37**	**26**	**10**	**35**	**108**
Beaver Cr-1	South Fork Yaak River	1	0	1	0	2
Beaver Cr-2	South Fork Yaak River	1	0	1	4	6
Browning Cr	South Fork Yaak River	0	0	0	1	1
Can Cr	South Fork Yaak River	3	2	0	0	5
Clay Cr-1	South Fork Yaak River	0	0	1	0	1
Clay Cr-2	South Fork Yaak River	2	9	0	4	15
Dutch Cr	South Fork Yaak River	3	5	0	0	8
Fix Cr	South Fork Yaak River	0	1	1	0	2
Fowler Cr-1	South Fork Yaak River	2	0	4	0	6
Fowler Cr-2	South Fork Yaak River	0	0	8	2	10
Hartman Cr	South Fork Yaak River	0	0	3	1	4
Kelsey Cr	South Fork Yaak River	3	3	3	3	12
Yaak R SF Trib-3	South Fork Yaak River	9	0	0	0	9
Yaak R SF Trib-4	South Fork Yaak River	0	0	0	1	1
Yaak R SF-2	South Fork Yaak River	4	3	1	7	15
Yodkin Cr	South Fork Yaak River	1	1	6	0	8
Zulu Cr-1	South Fork Yaak River	1	4	0	2	7
Zulu Cr-2	South Fork Yaak River	6	3	0	2	11
Yaak R SF	South Fork Yaak River	0	0	0	0	0
Yaak R SF Trib	South Fork Yaak River	0	0	0	0	0
Yaak R SF Trib	South Fork Yaak River	0	0	0	0	0
Smoot Cr	South Fork Yaak River	0	0	0	0	0
South Fork Yaak River Totals		**36**	**31**	**29**	**27**	**123**
Lap Cr Total		**6**	**0**	**16**	**1**	**23**

Table B-9. Seventeenmile Creek: Existing Annual Sediment Loads from Road Crossings

Seventeen Mile Creek Watershed		No. of crossings by IGBC Code				Existing Annual Sediment Load by IGBC Code (tons/yr)				
HUC7_Name	**Area (mi2)**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**TOTAL LOAD**
Bridle Cr	1.7	1	0	0	0	0.001	0	0	0	0.00
Conn Cr	2.3	13	0	0	0	0.013	0	0	0	0.01
Crum Gulch	2.1	0	0	0	1	0	0	0	0.6	0.60
Grush Gulch	2.3	0	0	0	0	0	0	0	0	0.00
Mule Cr	1.7	6	0	0	0	0.006	0	0	0	0.01
Papoose Cr	2.5	0	0	0	0	0	0	0	0	0.00
Pelham Cr	0.5	4	0	0	0	0.004	0	0	0	0.00
Saddle Cr	1.2	0	0	0	0	0	0	0	0	0.00
Seventeenmile Cr L	10.3	4	0	0	13	0.004	0	0	7.8	7.80
Seventeenmile Cr NF	4.2	0	0	0	1	0	0	0	0.6	0.60
Sheepherder Cr	1.8	0	0	0	0	0	0	0	0	0.00
Big Foot Cr	3.0	0	5	0	5	0	0.3	0	3	3.30
Flattail Cr	10.3	0	2	6	6	0	0.12	0.66	3.6	4.38
Hemlock Cr	3.7	2	0	0	0	0.002	0	0	0	0.00
Lost Fork Cr-1	3.4	6	9	0	0	0.006	0.54	0	0	0.55
Lost Fork Cr-2	2.4	1	2	0	0	0.001	0.12	0	0	0.12
Seventeenmile Cr U-1	3.4	0	4	0	2	0	0.24	0	1.2	1.44
Seventeenmile Cr U-2	5.6	0	4	4	7	0	0.24	0.44	4.2	4.88
Totals	**62.4**	**37**	**26**	**10**	**35**	**0.037**	**1.56**	**1.1**	**21**	**23.7**

Table B-10. Lap Creek Existing Annual Sediment Loads from Road Crossings

South Fork Yaak River Watershed		No. of crossings by IGBC Code				Existing Annual Sediment Load by IGBC Code (tons/yr)				
HUC7_Name	**Area (mi2)**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**TOTAL LOAD**
Lap Cr	5.8	6	0	16	1	0.006	0	1.76	0.6	2.37
Totals	**5.8**	**6**	**0**	**16**	**1**	**0.006**	**0**	**1.76**	**0.6**	**2.37**

Table B-11. South Fork Yaak River: Existing Annual Sediment Loads from Road Crossings

South Fork Yaak River Watershed		No. of crossings by IGBC Code				Existing Annual Sediment Load by IGBC Code (tons/yr)				
HUC7_Name	**Area (mi2)**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**TOTAL LOAD**
Beaver Cr-1	3.9	1	0	1	0	0.001	0	0.11	0	0.11
Beaver Cr-2	4.4	1	0	1	4	0.001	0	0.11	2.4	2.51
Browning Cr	1.0	0	0	0	1	0	0	0	0.6	0.60
Can Cr	1.4	3	2	0	0	0.003	0.12	0	0	0.12
Clay Cr-1	4.3	0	0	1	0	0	0	0.11	0	0.11
Clay Cr-2	5.0	2	9	0	4	0.002	0.54	0	2.4	2.94
Dutch Cr	2.4	3	5	0	0	0.003	0.3	0	0	0.30
Fix Cr	0.9	0	1	1	0	0	0.06	0.11	0	0.17
Fowler Cr-1	3.7	2	0	4	0	0.002	0	0.44	0	0.44
Fowler Cr-2	5.3	0	0	8	2	0	0	0.88	1.2	2.08
Hartman Cr	1.3	0	0	3	1	0	0	0.33	0.6	0.93
Kelsey Cr	2.0	3	3	3	3	0.003	0.18	0.33	1.8	2.31
Smoot Cr	2.3	0	0	0	0	0	0	0	0	0.00
Yaak R SF	1.9	0	0	0	0	0	0	0	0	0.00
Yaak R SF-2	10.2	4	3	1	7	0.004	0.18	0.11	4.2	4.49
Yaak R SF Trib-1	1.5	0	0	0	0	0	0	0	0	0.00
Yaak R SF Trib-2	1.6	0	0	0	0	0	0	0	0	0.00
Yaak R SF Trib-3	1.1	9	0	0	0	0.009	0	0	0	0.01
Yaak R SF Trib-4	1.3	0	0	0	1	0	0	0	0.6	0.60
Yodkin Cr	1.9	1	1	6	0	0.001	0.06	0.66	0	0.72
Zulu Cr-1	2.0	1	4	0	2	0.001	0.24	0	1.2	1.44
Zulu Cr-2	3.3	6	3	0	2	0.006	0.18	0	1.2	1.39
Totals	**62.7**	**36**	**31**	**29**	**27**	**0.036**	**1.86**	**3.19**	**16.2**	**21.3**

Table B-12. Seventeenmile Creek Road Surface Sediment Loading Reductions

HUC7_Name	Area Mi2	Crossing Density	Existing Sediment Load (tons/yr)	Allowable Sediment Load		Percent Reduction
				200ft contributing road length BMPs (tons/yr)	200ft contributing road length BMPs & road crossing density of 1.5 mi2 (tons/yr)	
Bridle Cr	1.7	0.6	0.00	0.001	0.32	
Conn Cr	2.3	5.7	0.01	0.013	0.45	
Crum Gulch	2.1	0.5	0.60	0.130	0.41	31.2%
Grush Gulch	2.3	0.0	0.00	0.000	0.45	
Mule Cr	1.7	3.6	0.01	0.006	0.32	
Papoose Cr	2.5	0.0	0.00	0.000	0.50	
Pelham Cr	0.5	8.7	0.00	0.004	0.09	
Saddle Cr	1.2	0.0	0.00	0.000	0.24	
Seventeenmile Cr L	10.3	1.6	7.80	1.694	2.01	74.2%
Seventeenmile Cr NF	4.2	0.2	0.60	0.130	0.81	
Sheepherder Cr	1.8	0.0	0.00	0.000	0.36	
Big Foot Cr	3.0	3.4	3.30	0.950	**0.58**	82.5%
Flattail Cr	10.3	1.4	4.38	1.560	2.02	54.0%
Hemlock Cr	3.7	0.5	0.00	0.002	0.71	
Lost Fork Cr-1	3.4	4.4	0.55	0.546	0.67	
Lost Fork Cr-2	2.4	1.2	0.12	0.121	0.47	
Seventeenmile Cr U-1	3.4	1.8	1.44	0.500	0.66	54.4%
Seventeenmile Cr U-2	5.6	2.7	4.88	1.590	**1.09**	77.7%
Seventeenmile Creek Total	**62.4**		**23.70**	**7.247**	**12.16**	**48.7%**

Table B-13. Lap Creek Road Surface Sediment Loading Reductions

HUC7_Name	Area Mi2	Crossing Density	Existing Sediment Load (tons/yr)	Allowable Sediment Load		Percent Reduction
				200ft contributing road length BMPs (tons/yr)	200ft contributing road length BMPs & road crossing density of 1.5 mi2 (tons/yr)	
Lap Cr Total	**5.8**	**4.0**	**2.37**	**1.896**	**1.13**	**52.4%**

Table B-14. South Fork Yaak River Road Surface Sediment Loading Reductions

HUC7_Name	Area Mi2	Crossing Density	Existing Sediment Load (tons/yr)	Allowable Sediment Load		Percent Reduction
				200ft contributing road length BMPs (tons/yr)	200ft contributing road length BMPs & road crossing density of 1.5 mi2 (tons/yr)	
Beaver Cr-1	3.9	0.5	0.11	0.111	0.77	
Beaver Cr-2	4.4	1.4	2.51	0.631	0.85	66.0%
Browning Cr	1.0	1.0	0.60	0.130	0.19	68.2%
Can Cr	1.4	3.7	0.12	0.123	0.27	
Clay Cr-1	4.3	0.2	0.11	0.110	0.84	
Clay Cr-2	5.0	3.0	2.94	1.062	**0.98**	66.8%
Dutch Cr	2.4	3.4	0.30	0.303	0.46	
Fix Cr	0.9	2.3	0.17	0.170	0.17	
Fowler Cr-1	3.7	1.6	0.44	0.442	0.72	
Fowler Cr-2	5.3	1.9	2.08	1.140	1.03	50.3%
Hartman Cr	1.3	3.2	0.93	0.460	**0.25**	73.4%
Kelsey Cr	2.0	6.1	2.31	0.903	**0.38**	83.4%
Smoot Cr	2.3	0.0	0.00	0.000	0.45	
Yaak R SF	1.9	0.0	0.00	0.000	0.37	
Yaak R SF-2	10.2	1.5	4.49	1.204	1.99	55.7%
Yaak R SF Trib-1	1.5	0.0	0.00	0.000	0.30	
Yaak R SF Trib-2	1.6	0.0	0.00	0.000	0.32	
Yaak R SF Trib-3	1.1	7.9	0.01	0.009	0.22	
Yaak R SF Trib-4	1.3	0.7	0.60	0.130	0.26	56.3%
Yodkin Cr	1.9	4.2	0.72	0.721	**0.37**	48.8%
Zulu Cr-1	2.0	3.5	1.44	0.501	**0.39**	72.8%
Zulu Cr-2	3.3	3.3	1.39	0.446	0.65	52.9%
South Fork Yaak Total	**62.7**	**2.0**	**21.29**	**8.596**	**12.23**	**42.5%**

ATTACHMENT B

WEPP: Road Modeling Results for Field Assessed Road Crossings

Table B-15. WEPP. Road Modeling Results From Field Assessed Crossings

Yrs	Climate	Soil	Rock (%)	Surface, traffic	Design	Road grad (%)	Road length	Road width	Fill grad	Fill length	Buff grad	Buff length	Precip	Rain runoff	Snow runoff	Sed road (lb/yr)	Sed profile (lb/yr)	Comment
30	TROY(248395) +	silt loam	30%	graveled high	outsloped unrutted	2	243	15.5 ft	55%	1 ft	0.30%	1 ft	37.74 in	1.31 in	0.04 in	513.6	320.45	SFY-1AB
30	BURKE 2 ENE +	silt loam	75%	graveled none	outsloped rutted	4	89	13 ft	75%	1 ft	0.30%	1 ft	48.90 in	1.42 in	0.39 in	41.21	30.33	SFY-2A
30	BURKE 2 ENE +	sandy loam	90%	graveled none	outsloped unrutted	6	162	13 ft	100%	1 ft	0.30%	1 ft	48.90 in	1.25 in	0.25 in	89.68	60.87	SFY-3A
30	BURKE 2 ENE +	silt loam	50%	graveled high	outsloped unrutted	2	241	16 ft	85%	1 ft	0.30%	1 ft	48.90 in	1.03 in	0.25 in	362.23	221.48	SFY-5A
30	Burke 2 ENE +	loam	10%	native none	outsloped rutted	5	122	19 ft	5%	119 ft	0.30%	1 ft	48.90 in	0.60 in	0.12 in	2.19	4.74	SFY-6A - Road to Fillslope
30	BURKE 2 ENE +	silt loam	40%	graveled none	outsloped rutted	1	245	16 ft	36%	1 ft	0.30%	1 ft	48.90 in	1.54 in	0.41 in	108.46	62.52	SFY-7A
30	Burke 2 ENE +	loam	0%	native none	outsloped rutted	2	95	12 ft	2%	92 ft	0.30%	1 ft	48.90 in	0.54 in	0.10 in	1.18	2.24	SFY-8A - Road to fillslope
30	Burke 2 ENE +	loam	0%	native none	outsloped rutted	2	480	10 ft	2%	477 ft	0.30%	1 ft	48.90 in	0.42 in	0.09 in	0.98	7.39	SFY-9A Road to fillslope - added 2 segments
30	TROY(248395) +	silt loam	20%	graveled high	outsloped unrutted	4	250	24 ft	56%	1 ft	0.30%	1 ft	37.74 in	1.70 in	0.08 in	1080.37	805.62	SFY-10A
30	BURKE 2 ENE +	loam	10%	native none	insloped bare	4	140	17 ft	65%	1 ft	0.30%	1 ft	48.90 in	3.69 in	8.69 in	138.87	107.91	SFY-11A
30	BURKE 2 ENE +	silt loam	10%	native none	insloped vegetated	2	500	22 ft	75%	1 ft	0.30%	1 ft	48.90 in	3.73 in	9.91 in	313.96	227.46	SFY-12A
30	BURKE 2 ENE +	loam	60%	graveled low	outsloped rutted	7	366	24 ft	75%	1 ft	0.30%	1 ft	48.90 in	1.92 in	0.53 in	913.41	851.2	SFY-13A
30	Burke 2 ENE +	silt loam	15%	native none	outsloped rutted	6	250	15 ft	42%	1 ft	0.30%	1 ft	48.90 in	3.69 in	9.04 in	496.71	387.1	SFY-14A
30	Burke 2 ENE +	loam	0%	native none	outsloped rutted	1	47	11 ft	1%	44 ft	0.30%	1 ft	48.90 in	0.55 in	0.10 in	1.04	0.75	SFY-15A - Road to fillslope
30	BURKE 2 ENE +	silt loam	25%	graveled none	insloped vegetated	4	865	26 ft	40%	1 ft	0.30%	1 ft	48.90 in	1.80 in	0.44 in	837.83	574.76	SFY-4B
30	BURKE 2 ENE +	silt loam	15%	native none	outsloped rutted	0.50	75	21 ft	40%	1 ft	0.30%	1 ft	48.90 in	2.73 in	6.67 in	47.48	32.21	SFY-5B
30	BURKE 2 ENE +	silt loam	15%	native none	outsloped unrutted	2.20	525	22 ft	42%	1 ft	0.30%	1 ft	48.90 in	1.83 in	3.20 in	433.31	224.11	SFY-6B
30	Burke 2 ENE +	silt loam	5%	native none	outsloped rutted	3.50	50	15 ft	3.50 %	47 ft	0.30%	1 ft	48.90 in	0.54 in	0.12 in	1.62	1.65	SFY-7B Road to fillslope
	BURKE 2 ENE +	silt loam	25%	graveled low	insloped bare	4.50	1250	25 ft	40%	1 ft	0.30%	1 ft	48.90 in	1.82 in	0.44 in	2692.42	2476.78	SFY-8B-LOW, used 1/2 length and doubled results
30	BURKE 2 ENE +	silt loam	15%	native none	outsloped rutted	5.70	255	41 ft	30%	1 ft	0.30%	1 ft	48.90 in	3.86 in	9.60 in	1464.97	1141.73	SFY-9B
30	BURKE 2 ENE +	silt loam	25%	native none	outsloped rutted	7.30	250	18 ft	12%	1 ft	0.30%	1 ft	48.90 in	4.15 in	10.05 in	783.93	612.32	SFY-10B
30	BURKE 2 ENE +	silt loam	20%	graveled high	outsloped unrutted	4.12	365	15 ft	30%	1 ft	0.30%	1 ft	48.90 in	1.46 in	0.30 in	784.52	467.77	SFY-11B - Reduce width to 15 feet
30	Burke 2 ENE +	silt loam	10%	native none	insloped vegetated	1	60	18 ft	1%	57 ft	0.30%	1 ft	48.90 in	0.51 in	0.13 in	1.75	1.45	SFY-12B Road to fillslope
30	Burke 2 ENE +	silt loam	5%	native none	outsloped unrutted	2	40	12 ft	1%	37 ft	0.30%	1 ft	48.90 in	0.60 in	0.16 in	1.2	0.33	SFY-13B Road to fillslope
Average - South Fork of Yaak River							**290.21**									**463.04**	**359.30**	**lb/yr**
																0.23	**0.18**	**tons/yr**
30	BURKE 2 ENE +	silt loam	10%	native low	outsloped rutted	2	130	18 ft	51%	1 ft	0.30%	1 ft	48.90 in	3.05 in	6.32 in	72.96	59.89	LSC-1A
30	TROY(248395) +	silt loam	35%	graveled high	outsloped unrutted	3	225	38 ft	80%	1 ft	0.30%	1 ft	37.74 in	1.76 in	0.11 in	1329.31	1068.5	SML-1-B
30	TROY(248395) +	silt loam	20%	native low	outsloped unrutted	1	360	18 ft	55%	1 ft	0.30%	1 ft	37.74 in	1.75 in	0.70 in	185.94	90.59	SML-2B - Modeled - native, low
	TROY(248395) +	silt loam	25%	graveled low	outsloped unrutted	5	625	20 ft	30%	1 ft	0.30%	1 ft	37.74 in	1.66 in	0.08 in	599.18	441.55	SML-3B - Modeled gravel, low
30	TROY(248395) +	silt loam	30%	graveled high	outsloped unrutted	5	725	22 ft	40%	1 ft	0.30%	1 ft	37.74 in	1.68 in	0.09 in	2761.92	2097.17	SML-4B
30	Troy (248395) +	silt loam	0%	native none	outsloped unrutted	5	100	16 ft	5%	97 ft	0.30%	1 ft	37.74 in	0.60 in	0.02 in	2.07	1.13	SML-5B Road to fillslope
30	Troy (248395) +	silt loam	0%	native none	outsloped unrutted	2	50	25 ft	5%	47 ft	0.30%	1 ft	37.74 in	0.71 in	0.04 in	2.87	1.34	SML-6B Road to fillslope
Average - Lower Seventeenmile Creek:							**316.43**									**707.75**	**537.17**	**lb/yr**
																0.35	**0.27**	**tons/yr**
30	TROY (248395) +	silt loam	15%	native low	outsloped rutted	3	322	12 ft	48%	1 ft	0.30%	1 ft	37.74 in	3.89 in	3.77 in	275.65	248.66	USC-1A
30	BURKE 2 ENE +	silt loam	5%	native low	outsloped rutted	3	700	20 ft	54%	1 ft	0.30%	1 ft	48.90 in	3.55 in	7.93 in	2511.28	2213.34	USC-3A
30	BURKE 2 ENE +	loam	5%	native none	outsloped unrutted	5	96	22 ft	28%	1 ft	0.30%	1 ft	48.90 in	2.35 in	4.47 in	93.05	55.41	USC-4A
30	BURKE 2 ENE +	silt loam	5%	native low	outsloped rutted	5	627	19 ft	72%	1 ft	0.30%	1 ft	48.90 in	3.67 in	8.03 in	4661.78	3873.89	USC-5A
30	BURKE 2 ENE +	loam	10%	native none	outsloped rutted	1.50	180	14 ft	45%	1 ft	0.30%	1 ft	48.90 in	3.66 in	9.01 in	70.75	48.57	USC-6A
30	BURKE 2 ENE +	silt loam	20%	native none	outsloped rutted	7	555	14 ft	64%	1 ft	0.30%	1 ft	48.90 in	3.56 in	7.29 in	594.02	457.59	USC-7A - Modeled 2 segments (inslope and outslope) and added results
30	BURKE 2 ENE +	silt loam	30%	native low	outsloped rutted	2	315	17 ft	64%	1 ft	0.30%	1 ft	48.90 in	3.97 in	8.39 in	240.87	211.95	USC-8A
30	Burke 2 ENE +	loam	5%	native none	outsloped unrutted	1	50	12 ft	1%	47 ft	0.30%	1 ft	48.48 in	0.64 in	0.14 in	1.17	0.4	USC-9A Road to fillslope
30	BURKE 2 ENE +	silt loam	70%	graveled low	outsloped rutted	1	345	13 ft	58%	1 ft	0.30%	1 ft	48.90 in	1.23 in	0.41 in	73.45	73.23	USC-10A
30	BURKE 2 ENE +	silt loam	50%	native low	insloped vegetated	5	1000	25 ft	46%	1 ft	0.30%	1 ft	48.90 in	5.80 in	10.22 in	6268.35	5773.65	USC-11A

Table B-15. WEPP. Road Modeling Results From Field Assessed Crossings

Yrs	Climate	Soil	Rock (%)	Surface, traffic	Design	Road grad (%)	Road length	Road width	Fill grad	Fill length	Buff grad	Buff length	Precip	Rain runoff	Snow runoff	Sed road (lb/yr)	Sed profile (lb/yr)	Comment
30	BURKE 2 ENE +	loam	5%	native none	outsloped rutted	0.50	195	15 ft	50%	1 ft	0.30%	1 ft	48.90 in	3.65 in	9.03 in	83.24	58.28	USC-12A
30	BURKE 2 ENE +	loam	5%	native none	outsloped rutted	2	252	11 ft	60%	1 ft	0.30%	1 ft	48.90 in	3.85 in	9.54 in	113.31	82.08	USC-13A
30	Burke 2 ENE +	silt loam	80%	native none	outsloped rutted	6	294	14 ft	6%	291 ft	0.30%	1 ft	48.90 in	0.74 in	0.29 in	10.13	8.49	USC-14A Road to fillslope
30	BURKE 2 ENE +	loam	95%	graveled none	insloped vegetated	5	184	13 ft	32%	1 ft	0.30%	1 ft	48.90 in	1.91 in	0.51 in	88.62	63.22	USC-15A
Average = Upper Seventeenmile Creek							**365.36**									**1077.55**	**940.63**	**lb/yr**
																0.54	**0.47**	**tons/yr**
30	Burke 2 ENE +	loam	50%	graveled none	outsloped rutted	5	450	19 ft	5%	447 ft	0.30%	1 ft	48.90 in	0.66 in	0.14 in	2.45	21.57	LC-1A, Road to fillslope
30	Troy (248395) +	loam	0%	native none	outsloped rutted	0.50	150	13 ft	5%	147 ft	0.30%	1 ft	37.74 in	0.57 in	0.02 in	1.3	6.62	LC-2A Road to fillslope
Average - Lap Creek							**300.00**									**1.88**	**14.10**	**lb/yr**
																0.00	**0.01**	**tons/yr**
Total Seventeenmile Average (Upper and Lower):																**954.28**	**806.14**	**lb/yr**
																0.48	**0.40**	**tons/yr**
Parallel Segments Removed from Model Results																		
30	Burke 2 ENE +	sandy loam	50%	graveled none	outsloped unrutted	3	140	13 ft	25%	3	40%	70	48.90 in	0.31 in	0.00 in	68.54	38.68	SFY-4A-P
30	Troy (248395) +	silt loam	7%	graveled low	outsloped rutted	7	800	20 ft	60%	20 ft	2%	10 ft	37.74 in	1.56 in	0.12 in	2877.54	2267.69	USC-2A-P
																1473.04	**1153.19**	**lb/yr**
																0.74	**0.58**	**tons/yr**
Decommissioned Crossings Removed from Results																		
30	Burke 2 ENE +	silt loam	20%	native none	outsloped unrutted	22	91	30 ft	22%	88 ft	0.30%	1 ft	48.90 in	1.31 in	1.08 in	36.37	14.66	SFY-2B Road to fillslope
30	Burke 2 ENE +	silt loam	25%	native none	outsloped unrutted	22	137	44 ft	22%	134 ft	0.30%	1 ft	48.90 in	1.28 in	1.10 in	88.84	29.1	SFY-3B Road to fillslope

ATTACHMENT C

WEPP: Road Model Adjustments

WEPP: Road Model Adjustments
Heavily vegetated road conditions encountered in the Yaak TPA are not properly represented in the standard WEPP:Road assumption. As a result, William J. Elliott, author of the model, was consulted to determine how best to represent these roads within the confines of the model.

There are three traffic scenarios available in the model. For roads where vegetation has grown up on the edges, the no traffic scenario is most appropriate as this scenario grows a limited amount of vegetation on the road. It uses the same plant growth for the road that the high traffic used for the fillslope. The following table explains the model assumptions for the three traffic scenarios:

Traffic	High	Low	None
Erodibility	100%	25%	25%
Hydraulic Conductivity	100%	100%	100%
Vegetation on Road Surface	0	0	50%
Vegetation on fill	50%	50%	100% Forested
Buffer	Forested	Forested	Forested

Based on conversations with Dr. Elliott, it was not appropriate to use the forest buffer to describe the road as the hydraulic conductivity of the soil would be too high. However, the hydraulic conductivity of the fillslope would be reasonable to use to describe the road surface for a fully forested scenario. This means, for the fully vegetated/forested road surface scenario, minimize the road segment length, put the remainder of the road surface length and gradient into the fillslope box, and minimize the buffer length and gradient at stream crossings. This was the approach that was used in the modeling work, and is noted as “Road to Fillslope” in the comment column of **Attachment B**.

ATTACHMENT D

Field Assessment Site Location Data

Table B-16. Field Assessment Site Location Data

LOCATION ID	HUC_6TH CODE	X	Y	Z
LC-1A	Lap Creek	-115.6871	48.8820	3581.53
LC-2A	Lap Creek	-115.6867	48.8801	3441.08
SFY-10A	South Fork Yaak River	-115.6630	48.8125	3279.02
SFY-10B	South Fork Yaak River	-115.6272	48.7722	4538.75
SFY-11A	South Fork Yaak River	-115.5799	48.8409	4547.34
SFY-11B	South Fork Yaak River	-115.6384	48.7631	3921.30
SFY-12A	South Fork Yaak River	-115.5673	48.8232	5237.62
SFY-12B	South Fork Yaak River	-115.6410	48.7714	3882.53
SFY-13A	South Fork Yaak River	-115.6130	48.8202	4221.00
SFY-13B	South Fork Yaak River	-115.6410	48.7736	3868.06
SFY-14A	South Fork Yaak River	-115.6212	48.8158	4066.20
SFY-15A	South Fork Yaak River	-115.6121	48.7975	4036.13
SFY-1AB	South Fork Yaak River	-115.6553	48.7610	3460.90
SFY-2A	South Fork Yaak River	-115.7125	48.7622	4171.17
SFY-2B	South Fork Yaak River	-115.6014	48.7258	4496.05
SFY-3A	South Fork Yaak River	-115.7080	48.7587	4034.56
SFY-3B	South Fork Yaak River	-115.6073	48.7378	4510.31
SFY-4A-P	South Fork Yaak River	-115.7080	48.7587	4034.56
SFY-4B	South Fork Yaak River	-115.6168	48.7405	4707.21
SFY-5A	South Fork Yaak River	-115.6748	48.7625	3513.30
SFY-5B	South Fork Yaak River	-115.6158	48.7330	4289.23
SFY-6A	South Fork Yaak River	-115.6760	48.7522	3938.15
SFY-6B	South Fork Yaak River	-115.6097	48.7328	4262.25
SFY-7A	South Fork Yaak River	-115.6795	48.7481	3992.83
SFY-7B	South Fork Yaak River	-115.6269	48.7311	3937.32
SFY-8A	South Fork Yaak River	-115.6612	48.7510	3770.70
SFY-8B	South Fork Yaak River	-115.6377	48.7290	3834.79
SFY-9A	South Fork Yaak River	-115.6523	48.7473	3546.55
SFY-9B	South Fork Yaak River	-115.6210	48.7641	4659.94
LSC-1A	Lower Seventeenmile Creek	-115.7275	48.6398	3291.19
SML-1B	Lower Seventeenmile Creek	-115.8511	48.6794	2652.57
SML-2B	Lower Seventeenmile Creek	-115.7477	48.6454	3312.61
SML-3B	Lower Seventeenmile Creek	-115.7491	48.6468	3265.97
SML-4B	Lower Seventeenmile Creek	-115.7679	48.6598	2961.35
SML-5B	Lower Seventeenmile Creek	-115.8153	48.6717	2944.64
SML-6B	Lower Seventeenmile Creek	-115.8075	48.6670	3130.26
USC-10A	Upper Seventeenmile Creek	-115.7378	48.5768	4673.81
USC-11A	Upper Seventeenmile Creek	-115.7284	48.5515	5535.16
USC-12A	Upper Seventeenmile Creek	-115.7586	48.5975	4390.28
USC-13A	Upper Seventeenmile Creek	-115.7510	48.5968	4291.36
USC-14A	Upper Seventeenmile Creek	-115.7539	48.5999	4277.85
USC-15A	Upper Seventeenmile Creek	-115.7057	48.6092	3602.33
USC-1A	Upper Seventeenmile Creek	-115.7157	48.6246	3379.28
USC-2A-P	Upper Seventeenmile Creek	-115.7151	48.6238	3359.96
USC-3A	Upper Seventeenmile Creek	-115.6634	48.6203	4181.79
USC-4A	Upper Seventeenmile Creek	-115.6714	48.6183	4100.11

Table B-16. Field Assessment Site Location Data

LOCATION ID	HUC_6TH CODE	X	Y	Z
USC-5A	Upper Seventeenmile Creek	-115.6824	48.6178	3838.58
USC-6A	Upper Seventeenmile Creek	-115.6972	48.6236	3704.32
USC-7A	Upper Seventeenmile Creek	-115.7136	48.5817	3988.61
USC-8A	Upper Seventeenmile Creek	-115.7034	48.5718	4085.63
USC-9A	Upper Seventeenmile Creek	-115.7248	48.5865	4491.59